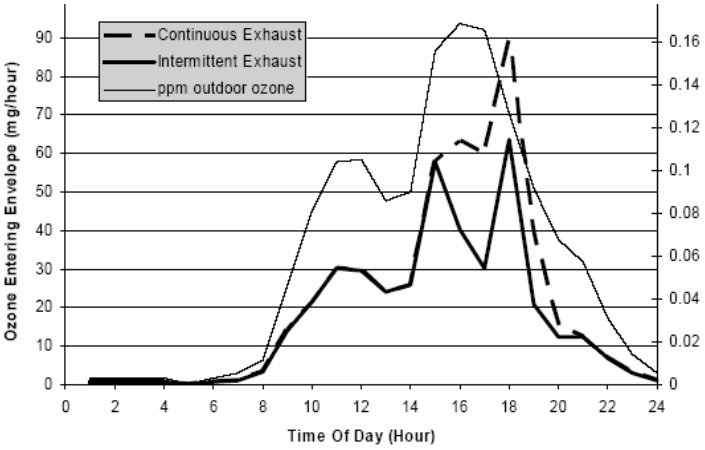
PIER Energy-Related Environmental Research
Environmental Impacts of Energy Generation, Distribution and Use

Ozone Reductions Using Building Envelopes

Contract #: MEX-07-07-03
Contractor: Lawrence Berkeley National Laboratory (LBNL)
Grant Amount: $75,000
Contractor Project Manager: Iain Walker
Commission Project Manager: Gina Barkalow
Commission Contract Manager: Beth Chambers

The Issue

The public health effects of ozone, a constituent of urban smog, have been reported in many other studies.[1] Ozone is associated with respiratory-related hospital admissions, lost school days, restricted-activity days, asthma-related emergency department visits, and premature mortality.[2]. As such, ozone represents a key health-related pollutant, and there are significant public health benefits to limiting exposure to ozone and its related reaction products.



Outdoor concentration profile and ozone entry rates for Riverside, with continuous and intermittent exhaust (from Walker and Sherman)[3]

In many regions of California, a significant source of ozone is outdoor air—which then infiltrates buildings, where people spend most of their time. Reducing indoor levels of ozone would lead to improved health for many California residents. There is the possibility that ozone may be effectively filtered by building envelopes; the magnitude of the reduction depends on the specific building materials that the air flows over and the geometry of the air flow paths through the envelope. With the proposed 2008 mechanical ventilation requirements for California's building standards for new con-

1. Weschler, C.J. 2006. "Ozone's Impact on Public Health: Contributions from Indoor Exposures to Ozone and Products of Ozone-Initiated Chemistry." Environmental Health Perspectives, Vol. 114. No. 10, pp. 1489-1486. U.S. National Institute of Environmental Health Services.

2. Bates, D.V. 2005. "Ambient Ozone and Mortality." *Epidemiology*, Vol. 16, No. 4, July 2005. Lippincott, Williams and Wilkins.

3. Walker, I., and M. Sherman. 2006. *Evaluation of Existing Technologies for Meeting Residential Ventilation Requirements.* California Energy Commission, PIER Buildings End-Use Efficiency Program.

struction (Title 24), there is a need to ensure that the mechanical systems have the flexibility to control the effects of outdoor as well as indoor pollutants while minimizing the energy impacts.

Project Description

This study—funded by PIER's Environmental Exploratory Grants Program—aims to investigate the potential reduction in indoor ozone levels for different methods of ventilation. This research will also examine the energy use associated with each method that successfully reduces indoor ozone. Study results will provide a basis for preferentially selecting and operating ventilation systems to optimize filtration effects, and possibly for developing building envelope technologies that can reduce ozone entry into buildings. The technical effort will concentrate on a literature review and exploratory engineering calculations, simulations, and modeling to determine if there is enough potential ozone filtering by the envelope to warrant further investigation.

A sophisticated building air flow model will be used to identify the quantity of air flowing through individual flow paths, including ducting, fans, walls, floors, ceilings, etc. Ozone deposition in these air paths will be modeled by combining the air flows through envelope components with previous results on the deposition of ozone on surfaces. The geographical locations used in the simulations will be areas with high outdoor ozone levels, such as Riverside and San Jose.

This research will address four key ventilation/filtration issues for controlling ozone entry:

1. **Quantity of air flow.** Generally, less air flow means less ozone transported into the building.
2. **Time of operation.** This allows for the possibility of reduced ventilation rates at times of high outdoor ozone concentrations. Ventilation would then be increased at other times to meet proposed Title 24 air flow requirements for minimizing exposure to indoor pollutants.
3. **Air flow path.** Envelope construction details affect air flow path geometry and consequent ozone deposition.
4. **Flow path materials.** Previous laboratory testing has shown that different materials have different reactions with ozone and, therefore, have differing filtration potential.

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objectives:

- **Providing environmentally sound, safe energy**. This study will assess the different options for controlling ozone entry rates in California homes, so that informed choices can be made by the Energy Commission, public health officials, homeowners, utilities, builders, equipment manufacturers, and other stakeholders.
- **Providing affordable energy.** The project will examine the costs of ventilating with different mechanical systems that could reduce indoor ozone exposure. The energy costs for complying with Title 24 ventilation requirements while controlling indoor ozone will be provided to Energy Commission and state public health officials.

Final Report

PIER-EA staff intend to post the final report on the Energy Commission website in summer 2008 and will list the website link here.

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